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TWO YEARS IN ARGENTINE AS THE CONSULTING
ENGINEER OF NATIONAL PUBLIC WORKS.

A LECTURE BY

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Mr. Chairman, Ladies and Gentlemen :

In 1899 the Argentine Government, having conceived an extensive project of river and harbor improvement, and made the preliminary surveys, requested the U. S. Government to recommend an engineer who would come to Argentine and assist the Government by his advice in forming and executing the plans.

I had the honor of being selected for this position. After carrying out a two years' contract with that Government, I have returned to my own country with some knowledge of the conditions and some experience in meeting them which form the basis of this lecture.

At the final general session of the International Navigation Congress at Düsseldorf, July 4th, this last year, when called upon to respond for the Argentine Republic, I used the following words:

It may not be out of place to make a few comparisons between the two countries which by a singular coincidence I have the honor to represent—one as a delegate to this Congress, the other as a member of the Permanent International Commission. One of these countries is the Argentine Republic and the other the United States of North America.

Both are cosmopolitan, both have been populated largely from Europe; both had the task of supplanting savagery by civilization. The red races in each case had to give way to the Caucasian, or be assimilated with it. Both have great plains and immense river systems. The greatest river valley of the one is almost exactly equal to that of the other. Similar causes have produced nearly similar hydraulic conditions in each case. Both countries have temperate climates, both great mountain ranges; both some extent of arid lands and running waters for irrigation; both immense

areas of rich soils, made so by similar beneficent causes; both have excellent pasture lands and millions of cattle, sheep, and horses. In their cereals they are competitors with each other in the food markets of Europe—one is great and ambitious, the other smaller but earnestly devoted to progress and ambitious to fulfill its high destiny among the nations of the earth.

I shall compare Argentine with the United States in respect to some of its more important features, and you will see that the two great countries have much in common.

You must, if possible, imagine yourselves in a situation exactly opposite from yours in the United States in regard to the sun and the poles of the earth; you must look north for warm winds and south for cold ones. Your winter will begin in June and your summer in December. The north side of your house will be sunny and the south side in the shade. As you travel north from Buenos Aires, the capital, it will grow warmer; as you go south you will at last reach the glaciers. Your north star will be changed to the Southern Cross, and in all these changes you will at first be lost. You must also locate yourself geographically, and recollect that the northern line of Argentine is in about the same latitude south of the equator as Havana is north of it, and that the southern limit of Argentine corresponds to Labrador and Kamchatka; and that Buenos Aires, Capetown, and Melbourne are all in about the same latitude. Also that there are east and west differences. Buenos Aires is in about the same longitude as Cape Breton Island, east of Nova Scotia, and the circle of longitude along the most westerly boundary of Argentine nearly passes through New York City; and the course from the entrance of the River Plate to Liverpool is nearly a straight line. In order that the location of Argentine in reference to other South American countries may be appreciated, it should be stated that Buenos Aires is as far south of, say, Caracas, the present centre of revolutionary and unstable South America, as the north end of Lake Winnipeg, in Manitoba, is north of Caracas, or as far as the northern part of Greenland is north of New Orleans.

With this orientation of ourselves on the Western Hemisphere, and with these remarkable differences in position, let me call your attention to a very remarkable similarity.

In a paper read before the American Association for the Advancement of Science, at Buffalo, Aug. 5, 1896, upon the delta of the Mississippi, I described the ancient conditions of that great river in substance as follows:

First, a deep shore-line of the Gulf of Mexico when the site of Galveston was far out in the waters and the coast was 100 miles

inland from the site of New Orleans; a wide and deep estuary, 1,000 miles long, reaching into the heart of the continent to between St. Louis and Cairo, where, at Cape Girardeau, it met the ridge of the Ozark Mountains, stretching across the valley and holding back the ancient Great Lake, which covered Chicago 200 feet deep, and spread over all the great prairie States, and received and distributed over its bed the immense sediments of the Missouri and other great rivers in the north. Then came the cyclic change, lifting Florida out of the water and turning continental drainage north, cutting its way through the alluvion to Hudson's Bay. Then the breaking down of the Ozark barrier; the draining of the submerged area; the subsequent filling of the estuary and the advance of alluvial lands into the Gulf to their present line, 110 miles beyond New Orleans—a great and wonderful beneficence for the use and convenience of man by the Great Architect of the universe.

Had not my engineering experience upon the Mississippi River and its delta drawn my attention to this extremely interesting ancient history of the great river of North América, I might not have been so deeply impressed by its remarkable similarity with that of the Paraná River in South America; and for both histories I am indebted to engineering investigators—Gen. Warren in the first instance, and Col. Geo. Earl Church, an American engineer living in London, in the second instance, the latter probably better acquainted by personal contact with the geography and hydraulics of South America than any living man.

I am indebted to him and the Royal Geographical Society, of which he is a Director and a Vice-President, for most of what follows in relation to this ancient history of the great rivers of Argentine and Central South America.

There are four great breaks in the mountain-fringed continent, and these we call its great commercial doorways. The Orinoco, the Amazon, the La Plata, and the deep indentation of Bahia Blanca—one in Venezuela, one in Brazil, and two in Argentine. The three river basins occupy two-thirds of the entire area of South America.

The two with which we are most interested in this lecture are the La Plata and the Amazon, which have areas respectively of about 1,200,000 square miles and 2,722,000. But if we deduct from the latter the valley of the Tocantins, which has no direct connection with it, the valley of the Amazon is 2,368,000 square miles; its principal branch, the Madeira, has a volume of discharge nearly equal to the Amazon itself, and at the falls, which I shall refer to

later, it carries annually a volume equal to that of the La Plata, which has a minimum flow of about 534,000 cubic feet per second, and a maximum of over 2,000,000—a river 80 per cent. larger than the Mississippi, the Father of Waters, if we compare their mean annual discharges, the former being about 288 cubic miles and the latter 156 cubic miles. The Paraná (“the mother of the sea” in the Indian language), the principal affluent of the La Plata, is itself 46% larger than the Mississippi, its mean annual discharge being about 230 cubic miles.

What a river the La Plata must have been in ancient times, when it had a maximum discharge of 4,000,000 cubic feet per second, well up towards the modern Amazon, estimated to be 5,297,000, and greater than the ancient Amazon!

I have described the ancient conditions of the Mississippi—the Gulf of Mexico as a great estuary, and a deep shore-line extending well into the heart of the North American continent. The same conditions existed in the contour line of South America in the La Plata estuary. It extended 1,400 miles into the continent, and was 400 miles wide—eleven times greater than the Empire State. It was the great Pampean Sea, receiving the drainage not only of the present Paraná and its tributaries, but of the great Madeira River, with its immense discharge of waters and sedimentary matters—the source of great alluvial formations, discharging into a sea two-thirds the size of the Mediterranean.

When, in the processes of nature, the great underwater plains of rich soil had been formed during the comparatively short period of less than 100,000 years, a dam was thrown across the Madeira by the rivers Grande and Parapití coming down from the Andes, and a deposit more than 170 feet deep occurred forming this dam, which produced the ancient Lake Mojos, with an area of about 115,000 square miles—larger than that of the Great Lakes of North America combined, which is less than 94,000.

The remarkable action of these rivers, and the changes caused by it, are graphically told by Col. Church in his paper upon *Argentine Geography and the ancient Pampean Sea*.

The Grande and the Parapití entered the plain with a northern trend to contest with the great river of the north the possession of the gap. They struck it almost at a right angle, and slowly pushed their rival eastward over against the Chaco base of the Chiquitos sierras. Here the final conflict must have taken place, as the Grande and Parapití threw their dam across the outlet of the Mojos River, thus cutting off its exit into the ancient sea. No doubt the giant stream waged fierce war for thousands of years to keep its channel open, alternately sweeping away the barrier, and again yielding to the ceaseless volume of sand and clay which, visible to-day, con-

firms the victory of the Grande and Parapití. The dam, having finally become permanent, the formation of the ancient Lake Mojos was assured. When it reached the level of the lip of Guajará-mirim, its waters commenced to tumble over it, and carved their way to the Amazon. Since then huge volumes of alluvium have poured down the northern slopes of the Bolivian Andes; the ancient lake is now almost loaded with material, but it is not yet entirely obliterated. The muddy silt which covers the surface of the basin is so fine that, when an Indian goes up stream to the mountains, his friends ask him to bring back a stone that they may see what it is like.

Since forming the dam the Rio Grande has slowly been returning westward down the counter-slope which its own alluvium creates.

During the process we have described the Ancient Lake and the Pampean Sea were connected, and their relation was similar to that of the Black Sea and the Mediterranean. Traces of it are still observable—notably the great, low, flooded morass of Xarayás on the upper Paraguay River, and the ancient delta of the Paraná, including the Ybará lagoon. The Salina Grande was also an arm of it—a great inland fiord. The sea, moreover, must have covered large areas of Paraguay, Corrientes, Entre Ríos, and Uruguay, and, before the uplifting of the country, it extended southwest to the Rivers Chadi-Leofu and the Colorado, lapping round the southern slope of the Ventana range until the curved rim, concave to the northeast, which connects this with the Sierra de Cordova, was sufficiently elevated to cut off completely its southwestern extension.

This range was high enough to lodge the glacial rocks coming from the Andes, one of which, at Tandil, is so poised and delicately balanced that the hand can rock it, but it cannot be dislodged. This range, later, prevented the entrance of the destructive sea, protecting the great area from its waves.

Then came another factor into the beneficent problem of the Creator. Instead of draining the waters from the great deposits under the Pampean Sea, as He did in North America, He lifted the Andes higher, and with them their Atlantic slopes, until the latter were ultimately lifted to their present level, forming the “Plains of the Pampas,” the soil of which is 50 feet deep, and of surpassing richness—an area of 600,000 square miles, one-fifth the size of the United States and five times that of Great Britain. Thus, by cyclic changes in the Northern Hemisphere, and by fluvial and sedimentary action, and seismic changes in the Southern Hemisphere, have been formed the great interior agricultural regions of the United States and Argentina.

Let me now quote from Mr. Revy's work on *Hydraulics of Great Rivers* (Argentine rivers which he surveyed), where he compares the rivers as we now find them with others well known:

Great as the volume of the Paraná River at its lowest summer level is, immense

in comparison to the largest European river, and much larger than that of all the European rivers put together, it is but a small fraction of its flood volume during exceptional rises; and we can only wonder at the magnitude of the sources which for months—nay, for whole years together—pour forth inconceivable masses of sweet water, every drop of which had been raised by the power of the sun from the Pacific and Atlantic Oceans above the tops of the highest mountains of Brazil and the Andes.

To convey an idea of the magnitude of the rivers which have been considered and analyzed in the preceding chapters, we have shown on Plate V several of the larger-known rivers, such as the Danube and Thames of Europe, and the Mississippi of North America. They are all drawn to the same scale, and their relative size may somewhat be appreciated. The Mississippi is not unlike the Uruguay in dimensions and other features. We have similarity in width, depth, currents and fall, although the North American is the larger of the two. Comparing, however, the Paraná with the Mississippi, the former might claim the latter as his eccentric daughter under fourteen. The low-water dimensions measure a river's greatness, although things of different natures and character do not bear strict comparison. What we, however, understand by greatness is possessed in an exceptional degree by the Paraná.

In order further to compare the Paraná River with others, it may be stated that its annual flow is double that of the Ganges, three times that of the Saint Lawrence, four times that of the Danube, and five times that of the Nile. We have records of 608 cubic miles in one year.

There are differing conditions of importance between the Paraná and the Mississippi, explaining the causes of the greater discharge of the Paraná. While they both flow south, one flows from colder to warmer and the other from warmer to colder regions; and it is in the warmer regions in both cases that the rainfall is the greater. On the Mississippi, in the northern regions, where we find the greatest drainage area, the rainfall is about 35 inches per annum; in the southern, where the area is less, the rainfall is 60 inches per annum. With the Paraná there is a rainfall of about 60 inches in the northern part, where the drainage area is greater, and about 40 inches in the southern part, where it is less.

The length of the Paraná River is about 3,000 miles; its navigable length, between Cuyabá in the north and the mouth of the Paraná in the delta of the La Plata, is 1,825 miles. The Uruguay River, from San Javier to the delta of the La Plata, has a navigable length of 603 miles. The Paraná River is made up of the two important rivers which unite at the City of Corrientes—the Paraguay and the Alto Paraná. The length of the latter above Corrientes to the falls of the Yguazú is 365 miles, and it is navigable nearly to that point. These wondrous falls excel in beauty, as well as exceed in dimensions, the Niagara Falls.

The latter are 160 feet high, as a maximum, and four-fifths of a

mile long, including Goat Island. The Yguazú are 213 feet high in one leap and 106 feet in two leaps, and $2\frac{1}{3}$ miles long, with at times an immense volume of water.

The gorgeous and varicolored foliage of the luxuriant sub-tropical vegetation, which abounds on all sides, adds a charm to the falls. They rank among the most beautiful and wonderful works of the Creator.

The remolinos, or whirlpools, below the falls equal the famous whirlpool at Niagara.

The Uruguay is an entirely different river in every respect from the Paraná. It is at times a mighty river, rivalling the Paraná; at others it sinks into comparative insignificance. The Paraná is a great river at all times.

The Paraná is a type of a truly great river; the Uruguay represents a mighty torrent of extraordinary dimensions.

The Uruguay rises near the Atlantic seaboard in Brazil, in the Serra do Mar, then runs west to the highland of the territory of Misiones. These highlands prevent it from uniting with the Alto Paraná River at that point, which is only about 68 miles distant. Along 600 miles of its course, from San Javier to Concordia, the bed of the river is filled with rocky ridges, which, at low water, prevent continuous navigation; but during the floods, which are quite sudden, but not long-continued, the river is everywhere navigable. The river rises, in floods, at Concordia about 46 feet. Compared with the Paraná, it is a clear stream, carrying very little sediment in suspension. The Paraná is an entirely different river. Its source being in the tropical and rainy region of Brazil, on the flanks of the Andes, its floods are much longer-continued. At the confluence of the Paraná and the Alto Paraná at Corrientes the rise of the floods is about 33 feet; at Rosario, 225 miles above Buenos Aires, it is from 19.7 to 23 feet, or $23\frac{1}{2}$ feet in extreme floods. When these occur the river is about 23 miles wide, covering the entire country to a depth of from 6 to 10 feet, and extending to the highlands of the Province of Entre Rios.

The physical characteristics of the bed of the river are, consequently, entirely different from those of the Uruguay; the bed of the latter is stable, that of the former very unstable. The sedimentary matters carried in suspension, however, are very much less than those of the Mississippi—probably only one-tenth of the amount carried in the Mississippi in times of flood. For this reason the changes in the bed and banks are less radical; the most noticeable change is the movement of the island and bars down stream. For

example, the Island of Espinillo, in front of the City of Rosario, lying in the middle of the river and about $2\frac{1}{2}$ miles long, has moved, flanking down stream about $2\frac{1}{2}$ miles in the last 50 years, and by this movement the advancing bar of the island has approached the river bank in front of Rosario and closed up the navigation channel.

The maximum velocity in great floods often reaches $6\frac{1}{2}$ feet per second, although usually it is much less—equal to that of the lower Mississippi.

Both rivers are susceptible of improvement by dredging, the Parana to Asunción, which is 842 miles above the mouth, and the Uruguay to Concordia, which is 230 miles above its mouth. In the Paraná there is nothing but sand to be removed throughout its entire length; in the Uruguay there are several places where it is necessary to remove rock and gravel. But, generally, the channel can be deepened by hydraulic or suction dredging.

The National Government is under obligation, by the law passed by Congress for building the Port of Rosario, to make and maintain a depth of 21 feet at low water in the Paraná River from the head of the delta to Rosario, and in the delta of the La Plata to Buenos Aires a depth of 19 feet at low water, which is about 21 feet at mean high tide. It has been proposed to make and maintain a channel of the following dimensions: From the mouth of the two rivers, at the Island of Martin Garcia, at the head of the La Plata estuary, to Rosario, a depth of 21 feet and a width of 328 feet; Rosario to Santa Fe, 292 miles above Martin Garcia, 19 feet deep and 328 feet wide; Santa Fé to Corrientes, 10 feet deep, and the same depth to Asunción. Santa Fé, or its seaport, Colastiné, is the head of ocean navigation; above that point it is river navigation by steamboats.

On the Uruguay River it is proposed to make a channel 19 feet deep and 328 feet wide, from Martin Garcia to Concepción del Uruguay, 137 miles above Martin Garcia, and thence 15 feet deep to Colon, and 9 feet deep and 8 feet over the rock to Concordia, which is 230 miles above Martin Garcia.

The low-water plane, or zero, in both rivers is that of extraordinary low water, so that, generally, the low water does not reach this plane within about half a metre to one metre. Consequently, there can generally be depended upon from 2 to 3 feet more water than I have stated. Between Rosario and Buenos Aires there is now no bar over which there is not 21 feet of water at zero, although two bars need to be dredged and buoyed in order to make a straightened channel. This the Government is prepared to do.

As to the Port of Rosario a contract has recently been made, under the law of Congress, to make a modern seaport at this point, with all the latest and best facilities for handling cargo. The commerce at Rosario is at present $1\frac{1}{2}$ million tons per annum. It is a very important exporting point for cereals, and when the port is completed according to the plans adopted it is expected to be a great importing port as well. There are ports below Rosario, such as Villa Constitución, San Nicolas, and San Pedro, and above Rosario, Diamante, Santa Fé, Colastiné, and Paraná. On the Uruguay River, Concordia, at the head of the steamboat navigation, is an importing and exporting port for that section of the country. Its registered tonnage is about half a million tons, and the actual weight tonnage about 100,000.

The country between the Paraná and Uruguay rivers is practically isolated from the rest of the country, and its situation is very similar to the country lying between the Euphrates and the Tigris; for that reason it has been called the *Mesopotamia Argentina*.

There are at present in this area three railroad systems—the Argentine North Eastern, which runs from Corrientes, on the Paraná, to Monte Caseros, on the Uruguay, and from there to Santo Tomé, on the same river; the Argentine Eastern from Monte Caseros to Concordia, and the Entre Rios railroads, the main line of which connects Paraná and Concepción del Uruguay, with branches to Victoria, Gualeguay, Gualeguaychú, and Villaguay. Within a few months a connecting line will be completed to Concordia, forming a link between the Argentine Eastern and the Entre Rios systems. It has been proposed to unite these three systems and to extend the Argentine North Eastern from Santo Tomé to Posadas on the Alto Paraná, passing through the colonies which the Government is establishing in that territory. Posadas is its capital. The Central Paraguay Railroad, which runs in a southeasterly direction from Asunción, it is proposed to extend to Villa Encarnación, a small town on the opposite side of the river from Posadas; to change the gauge, which is $5\frac{1}{2}$ feet, to the normal gauge of the other three railroads, which is 4 feet $8\frac{1}{2}$ inches; make a transfer by car float at Posadas; extend the Entre Rios railroads to a port of deep water, either on the Paraná or Uruguay, and do a “through” business between Asunción and this new seaport, which will be only a few hours distant from Buenos Aires.

With the Paraná River improved to Asunción, and the Uruguay improved to Concordia, with the railway systems united and ex-

tended to a good seaport, this great interior district of the country will have an ideal system of transportation, and the shipper may take his choice, to ship by rail or by water, thus establishing a very useful and reasonable competition between water and railway, to the great advantage of the people.

In reference to the Rio de la Plata itself, it is an immense shoal estuary. It is the depositing-ground of the great Paraná River. This estuary, in a not very remote period, extended above Santa Fé; this is shown by the comparison of old maps, of which 92 have been collected and copied and placed in the library of the Ministry of Public Works. These maps date from the year 1529 to 1885. Even in this comparatively short period remarkable changes are shown in the delta of the Paraná, which is now a true delta, almost exactly in the form of the Greek letter Δ . It is 40 miles across its face; it slowly extends itself in the head of the estuary, and through the delta nearly a dozen outlets of the Paraná River find their way. It is very much like the deltas of the Danube, Ganges, and Mississippi.

The superficial extension of the Rio de la Plata exceeds 18,000 square miles; it is about 186 miles long, and varies in width from 186 miles at the ocean, between Capes San Antonio and Santa Maria, to 1.12 miles at the extreme point of the head of the estuary, at Punta Gorda.

To understand the physical conditions of the estuary, it is necessary to divide the Rio de la Plata into Superior and Inferior, or upper and lower. The Rio de la Plata Superior lies above a line extending between La Plata and Colonia; the Inferior below that line to the sea. Over a distance of about 25 to 30 miles between Martin Garcia and the anchorage of Buenos Aires there is a normal depth through the best channels of from 16 to 20 feet at low water.

The National Government has recently completed the dredging over the San Pedro bar lying in this region, increasing the depth of 18½ feet to 21 feet where there was formerly only 15 feet. In the Canal de las Limetas, or Nuevo Canal, by natural forces and by the constant movement of steamers, there has been obtained a depth of about 19½ feet, or 21½ feet at mean high tide. Opposite Farallon, a rocky point on the Uruguay shore and opposite Buenos Aires, there is, along the course of navigation, about 19½ feet at low water. The Government has buoyed with luminous buoys the entire route from Buenos Aires to the mouths of the Paraná River, the Bravo, and the Guazú, and has placed a floating

semaphore below Martin Garcia for the benefit of navigation, recording constantly by signals by day and by night the depth of water in the channel. It is now proposing to connect this semaphore by a telephone cable with the telegraph cable of Martin Garcia, so that communication may be established between the ships lying at anchor (waiting for the tide, or passing near the semaphore) and the offices of the agents at Buenos Aires or Monte Video.

A careful study of the different conditions in the delta of the La Plata shows that the only method of improvement in such a vast expanse of water is by dredging and buoying the best channels.

In the lower Rio de la Plata there are very serious conditions. A bar on which there is a least depth of 20 feet at low tide lies between the anchorage of Buenos Aires and Monte Video; the material in this bar is very soft, and vessels plough their way through it on ordinary tides; but the great extent of the bar is the serious condition. Between the 24-foot curves, straight through this bar, there is a distance of 24 sea miles. To make a channel by dredging would require the removal of probably $10\frac{1}{2}$ to 13 million cubic yards; and it is very doubtful if, on such broad extension of water and in such soft material, a channel could be maintained. But it is hoped that the plan now proposed of anchoring five lightships in the line of navigation and in the direction of the current, and which can be seen from each other, will have an effect upon the bar by the continued movement of deep steamers through it. The examination of the Rio de la Plata Inferior has been intrusted by the Government to the Ministry of Marine, which is making very extensive surveys and examinations over the entire area.

The estuary at this point is 46 miles wide, and five high towers on shore and others anchored within the area to be surveyed are necessary in order to cover this great Punto Indio bank.

These are the general physical conditions of the Rio de la Plata and its great tributaries.

The very important project of making a deeper channel of access to the Port of Buenos Aires and enlarging the port, to give it not only a greater area and more facilities, but greater depth in the enlarged part, is now before the Government, and the plans for it—made by myself—have been approved. There are alternative projects to meet the commercial necessities of the country: one is to deepen the present Port of La Plata, and endow it with more facilities, where vessels drawing 24 or 25 feet may come in and go

out at any stage of the tide; or to build a deep-water port, with a depth of not less than 30 feet, on the seaboard outside of the difficult conditions of the Rio de la Plata. A concession has been granted, and the project submitted to the National Government, for an artificial port in the great bay of Samborombon, which is nearly opposite Monte Video; and another concession for a port at Mar Chiquita, near Mar del Plata, on the ocean, has also been granted.

In addition to the great drainage basin of the La Plata, there are further south the large rivers Rio Negro and Colorado, which combined have a drainage area of 464,000 square miles. The channels are not susceptible of improvement for a large commerce; but they will in the future furnish water for an extensive irrigation and steamboat navigation.

The hydraulic conditions are great; but the mountains are greater, and have exerted a powerful influence on the continent, not only its climate and its running waters, but upon mankind. On these lofty table lands lived the Incas and flourished their great empires. Among the clouds have fought for supremacy the Incas troops and the Spanish soldiers. And here, too, have the struggles for liberty taken place; here Bolívar and San Martín led their troops to victory and continental freedom from the domination of Spain.

An orographic map of South America will show what immense areas are given up to mountain ranges and lofty summits. In their widest part the Andes are 500 miles in breadth. Some mighty force seems to have pushed them and the entire continental line eastward, and massed the ranges into a complex system of mountains, towering isolated peaks, and parallel, transverse, and interlaced ridges without number. In Bolivia, not far north of the country we are describing, there are thirty-two peaks above 17,000 feet high, some of them reaching over 21,000 feet; and in Argentine is the lofty Aconcagua, lifting its solitary crown to an elevation of 23,080 feet, rivalling the loftiest mountains of the world. And Famatina, in the Argentine Province of Rioja, rises to 20,680 feet, and the grand mountain Tubungato is 22,015 feet high.

Between Argentine and Chile, between latitude 23° and 35°, the mountain passes, which are from 10,000 to 14,000 feet high, are blocked with snow from May to August, and they are swept by violent storms.

The height of the passes, all the way from 7° to 37° south lat., Northern Peru to Southern Argentine, shows the determination of

nature to oppose transit by man, piling up in his pathway these almost insurmountable obstacles. When it is considered that this immense barrier covers a sixth part of the circumference of the globe its influence upon the development of the continent is apparent. The general condition, as far as civilization is concerned and the obstacles in the way of mankind, are forcibly and most interestingly described by Col. Church, comparing them with the conditions in North America :

The contrast between North and South America is remarkable. Nature was in her kindest mood when she created the former—gave it vast and fertile plains; low and readily transitable mountain ranges; extensive systems of navigable lakes and rivers, the latter not too difficult to bridge; great forests of the most useful timber immense mineral wealth, including an abundance of coal and iron; a coast-line offering numerous excellent harbours easily accessible from the interior, and a temperate, inviting climate over almost its whole area. It is a land where man seems to live with nature on friendly terms, and where the wave of humanity, as it rolls westward, encounters no obstacle which it cannot readily overcome.

How opposite to all this is South America ! It lies mostly within the tropics; its fertile plains, except those of the Argentine Republic, are difficult of access; it is a formidable task to scale and cross its mountain ranges; its rivers, with rare exceptions, are of violent flow and full of obstacles to navigation, and its largest ones not within the limit of practical engineering to bridge; its vast forests are hard to work and frequently impenetrable; its mineral wealth, immense in nobler metals, includes but little coal and iron; its coast has but few good harbours, and these are almost all mountain-locked; its climate, although in many parts delightful, is uninviting over extensive regions; the forces of nature are so vigorous that man can seldom count upon the unqualified control of them, and, in general, they confer generous reward only upon well-applied and persistent energy.

The above is an introduction to his very important paper read before the Royal Geographical Society, Feb. 25, 1901, entitled "South America: An Outline of its Physical Geography," a paper of 74 printed pages. His conclusions are as follows :

My analysis shows that, in general, man finds himself confronted by severe conditions in his struggle with nature in South America. Thus far, however, his efforts to develop and utilize its vast resources have made its commercial history an epic. The thought naturally presents itself that had North America fallen to the lot of the Latin race in the European occupation of the New World, and South America to the Anglo-Saxon, the former might still have maintained its old supremacy; for the more rapid progress of the latter may not be due so much to racial superiority as to advantageous geographical surroundings.

Argentine is a country one-third the size of the United States; a climate salubrious and comfortable; of immense plains formed by nature, as I have already shown, for the use of man—plains where the railroads find no natural obstacles worth mentioning in the way of their good alignment and construction; where we have, I think, the longest railroad tangent in the world (186 miles), between Junin

and La Cautiva, on the Pacific Railroad; plains covered with the cattle of the great estancias, thousands of them of the best breeds in one estancia, and sheep by the millions, and great fields of wheat, corn and linseed, the principal agricultural products of the country. An "estancia" might be called a "ranch" on the great plains of our Western States. Their size varies from about three thousand acres to seven hundred thousand acres; probably twenty-five thousand acres might be considered an average size.

As might be expected, the business of cattle-raising requires expert men similar to our cowboys; they are called "gauchos." They are fearless riders and masters of their trade. The horses they ride are generally rather undersized, but wiry and of great endurance. They are much like the best class of Mexican horses.

As the cattle roam over great ranges, which are unfenced, it is necessary to brand them, as we also do on our great plains.

The homes of the gauchos on the estancias are not elegant, to say the least, but in the comparatively mild climate of Argentine they do not need as much protection from the weather as in many of our cattle districts of the Far West. They are a contented people, and while they do not have the facilities for entertainment which a city population has, they nevertheless have their own fun on feast days and whenever their arduous and roaming life will permit.

As might be expected of a country stretching through so many degrees of latitude and rising from the level of the sea to the highest Andes, there is a great variety of climate and generally an abundant rainfall. Buenos Aires is on the same parallel south of the equator as Wilmington, North Carolina, is north of it. Snow is almost unknown, and scarcely ever is ice or frost seen. The climate in the summer is tempered with the great body of water of the River Plate.

The rainfall of Buenos Aires averages $35\frac{1}{2}$ inches per annum—about equal to that of the Northern States of the United States. At Asunción, Paraguay, it is 53 inches—about equal to that of New Orleans. The temperature is remarkably uniform. The mean temperature in June and July, 1899, the coldest months, was 54° (F.), and in January and February, the hottest, 76° ; the annual mean being 62° . In twenty years the mean was 63° ; summer, 77° ; autumn, 65° ; winter, 54° , and spring, 63° ; mean of January, the warmest month, 79° ; of July, the coldest, 52° . The extreme, or extraordinary, limits were 107° , and very rare 104° , frequently 95° , and in winter 23° , which occurred but three or four times. In February, 1900, the heat rose to 103° , but the period of intense heat was only eight days. Such conditions are extremely rare.

The agricultural, industrial, and commercial features are those of greatest interest, and yet to give an adequate idea of them we must take figures.

The population of the whole country is now about 5,000,000; its present rate of growth per decade is about 40 per cent. The United States is 20 per cent., Germany 16 per cent.

The Province or State of Buenos Aires is as large as Illinois, Indiana, Maryland, Connecticut and Massachusetts combined, or two and one-half times as large as New York State—120,000 square miles, and mostly plains, with 750 miles of coast-line. It has 1,200,000 inhabitants, 10,000,000 head of cattle, 80,000,000 sheep, and 2,200,000 horses. In 1901 it raised 762,000 tons of wheat and 1,360,271 tons of corn—a respectable showing; and the value of agricultural and pastoral products was \$740,000,000. The wheat area of the Republic, mostly in four provinces—Buenos Aires, Santa Fé, Cordoba, and Entre Rios—is about 8,500,000 acres, and 80,000,000 to 100,000,000 bushels of wheat are exported. The total area under cultivation in the Republic in 1901 was 17,500,000 acres. The increase over 1891 was 136 per cent. The crops were: Wheat, 1,964,000 tons; linseed, 490,000 tons; corn, 2,134,000 tons. The total of arable land is 253,000,000 acres, of which 240,000,000 do not need irrigation.

In the whole Republic there are over 30,000,000 head of cattle. The annual increase is 25 per cent. There are 5,600,000 horses and 120,000,000 sheep (in the United States there are 62,000,000). The annual increase in Argentina is 33 per cent., and 3,000,000 carcasses were sent to Europe in 1901.

One of the important industries of the country is the “saladeros,” which from its name signifies salted or jerked beef and extract of beef, etc. Nearly \$40,000,000 are invested in them. Brazil is the principal market. Over 1,000,000 head of cattle were killed for the saladeros in 1900. The meat-freezing factories exported 100,000 tons of meat in 1901. An important factor in the Argentine meat trade—and, it may be said, in the meat trade of the world—is the successful result of continued efforts to send chilled meat to Great Britain. The River Plate Fresh Meat Company started this trade in 1901, exporting in that year 29,919 quarters of beef; and from January 1st to May 31, 1902, five months, it exported 38,148 quarters. Since that date the imports into Great Britain have rapidly increased, and recent dispatches from London relate how this factor in the London meat market is alarming the Beef Trust of the United States and the Australian shippers. Argentine is placing its chilled

meat in London at a considerably lower price, and is competing successfully with meat from the United States.

As might be expected, the wool industry is very important, about one-half million bales shipped to Europe, being the export product in the year 1901-1902—31,000 to United States and 28,000 to Great Britain.

Argentine is a protectionist country, and its resources for conducting the Government are largely raised from the Custom dues. In 1899 the imports free of duty amounted to \$14,769,933 (gold), and those subject to duty \$102,080,738 (gold). The exports were \$184,917,531 (gold). The United States imports 300 millions per annum of sugar, hides, linseed, jute, hemp, wood, and fruit, and 36 million of wool and woollen articles. All of these are produced by Argentine; yet only 6 millions of the 336 millions come from Argentine, or two per cent.

The United States exports, including cereals, meat, and live stock, are about 920 millions, and only 10 millions of this go to Argentine, or about one per cent.; while Argentine's purchases of the same articles in England were 39 millions, and 60 millions from other countries.

A volume would be required to take up the subject of the savage tribes alone of America—450 principal groups, and 2,000 if we separate them by dialects. And another volume would be needed to treat of the civilized aborigines of the table lands of Mexico and Peru; of the Toltecs and Aztecs and of Quetzalcoatl and the Incas—the pontifices who ruled over a vast population covering 40 degrees of latitude of South America from Northern Argentine to the Antilles. The barbarism of the savage and the civilization of the races of the table lands have nearly disappeared. You would have no better knowledge of that vast horde of wandering tribes that infested the great plains of the Pampas if I should mention their names. Some few still exist; the census gives less than 20,000 as the total of Indians still existing in Argentine. Once numerous and brave, only about a dozen remain of the Paraquas—the descendants of the Aguas—and of the Tobas and Chinipis, who later occupied their country, a remnant only exists.

It may not be generally known that, from the first arrival of the Spanish adventurers to the successful end of the great struggle for liberty in South America, there was always dissatisfaction, unrest, and hatred of the conquering race. The seeds were sown in bloodshed, in the persecution by the Inquisition, and in false commercial and governing methods of Spain and Portugal, the mother coun-

tries. The difference between North and South America in this respect was very great.

The symptoms of resistance against Spanish domination showed themselves in the dawn of the history of South America. Frequently the Indian tribes attempted to throw off the yoke of some more than usually severe and cruel oppressor. In the early days of the 18th century the revolution of Tupac-Amaru was really a war of races rather than a political revolution, as it had for its principal purpose the extermination of the Spanish. In Venezuela in 1711 this same hatred showed itself in the proclamation of a mulatto as King of the Mestizos. Half a century later the seed sown by Antequera bore fruit in New Granada.

We may say that the struggle and the preparation of the ground for civil and religious liberty began earlier in South America than in North America. In the British Colonies there was no strong sentiment against foreign rule until the imposition of the taxes required to furnish George the Third with revenue to pay off his debt of 148 million pounds sterling. Even Washington, in July, 1775, when he took command of the Continental army, declared that the idea of independence was repugnant to him. Only later did events hasten and make inevitable the separation from the mother country.

It would be a subject of great interest to enter upon—the three great leaders and heroes of American revolutions—

WASHINGTON—BOLÍVAR—SAN MARTÍN,

a triumvirate of liberators.

Of the two former you already know much, possibly, also, of the last; but you may not know that it was by his patriotism and generalship that the whole of southern South America was freed from the yoke of Spain—Argentine, Chile, Peru, and Bolivia. His biography is a romance of most absorbing interest.

Born in 1778, in Argentine, in Japeyú, his early education was in Buenos Aires, completed in Spain. He served with distinction and great bravery in the wars of Spain. Early he was imbued with the doctrine of liberty for his native country; spent a year in Great Britain in 1811 forming associations and a secret league devoted to the liberation of Argentine. Landed in Buenos Aires in 1812; soon in command of a regiment of grenadiers; selected soldier by soldier, officer by officer, imposed the most rigid discipline. Placed in command of the army to reorganize it, he marched to Mendoza, the nearest point to the Andes; and, imbued with the idea that no

liberty would be secure for his country until the Spanish armies were beaten and expelled from Chile, Peru, and Bolivia and the whole of South America, he formed his plans for an invasion of Chile. He was the very incarnation of determined patriotism; nothing, not even revolutions and discord behind him in his own country, could deter him from his great work. At this moment Napoleon fell, and Spain prepared an expedition of 15,000 men destined for the Rio de la Plata. In Chile and Peru the Royalists were victorious; but in Argentine on the 9th day of July, 1816, at Tucuman, the declaration of independence was proclaimed, which, like our own, is sacred in the heart of every Argentine.

In the midst of these great and momentous events, San Martín recruited and drilled and clothed and provisioned his little army destined to conquer a continent, to scale high mountain passes, and pour down upon an enemy largely outnumbering his own. His plans were known only to himself, and when asked by those high in authority what they were, he refused to tell, and said no one should know them; and should his pillow get an idea of his plans, he would cast it into the fire. He ostensibly made roads over certain passes, and, when all was ready, led his army over another and very different pass and came down upon his foe and defeated him in Chacabuco; and again on the plains of Maipu, routing the enemy completely and assuring the independence of Chile. Then, though anarchy was reigning in Argentine and his Government was calling upon him to return, his fixed and irresistible purpose of dealing the final blow to Spanish authority in Peru pushed him forward. With a fleet commanded by Lord Cochrane, and with English and U. S. officers in command of the ships, he sailed from Valparaiso with his troops up the coast in December, 1818. He had only 4,430 men, Argentines and Chileans. The Viceroy of Peru had 23,000 soldiers awaiting this little army. On July 28, 1821, as a result of his campaign, the independence of Peru was proclaimed in Lima and San Martín made dictator. In the meantime General Bolívar, after liberating Venezuela and Colombia, reached Quito, and his forces, united with an Argentine division, routed the Spanish army in the battle of Pichincha.

The two liberators had a conference July 26, 1822, the details of which were kept secret; but it is a well-known fact that San Martín comprehended that, in order to accomplish South American independence and avoid the scandal to the world of a break with Bolívar, caused by the latter's thirst for glory, it would be best for him to depart from a scene where his great presence had no place.

He resigned the dictatorship of Peru; passed to Chile, to Mendoza, to Buenos Aires, to Europe, where he resided four years in Brussels on a very modest pension. Once more, in 1829, he returned to La Plata; but learning that anarchy prevailed in his own country, and deaf to the entreaties of his friends to come to their help, he returned to Europe, saying "No; General San Martín will never spill the blood of his fellow-citizens; he will draw the sword only against the enemies of America." And, without even seeing Buenos Aires, he sailed for the last time to his voluntary exile, dying suddenly August 19, 1850. He was free from those theatrical qualities which appeal to the multitude. In this great character predominated those moral qualities which entitle San Martín to a prominent place in South American history. Inflexible in the discharge of duty, a rigid disciplinarian, everything was subordinated to the high mission to which he had devoted himself, and he never sacrificed his cause to ambitious or personal vain glory. He was the incarnation of an idea. His modesty, his pure and elevated character, the simplicity of his life and the nobility of his principles give him rightfully a position by the side of the great heroes of history.

Reciprocal trade would open the United States to Argentine wool and treble the production in a few years. There should be direct lines to that country from the United States, and the time should be reduced from about 27 days to 15 or 18 days. We should ship to Argentine our manufactures, our coal, pine wood, petroleum, etc., and we should receive from Argentine its wool, hides, grease, dried fruits, hard wood for tanning and dyeing, etc. Now, for want of return freights, steamers load at United States ports for Buenos Aires, and return via Liverpool to New York, frequently via South Africa.

In reference to wool, I have already stated that in the entire United States there are only about 62 million sheep; while there are 120 million in Argentine. It is a well-known fact that the ranges in the Far West of the United States, which are absolutely necessary for sheep-raising, are rapidly being reduced by the extension of our population westward and the cutting up of great areas into smaller farms. Not only do the smaller farmers as they go west wage constant war with the sheep herders, but the cattle-raisers do the same; so that the time is sure to come very soon when we will need the wool of Argentine. What this country should do with a great agricultural country like Argentine, capable of immense productions, is to receive its raw materials and ship to it our manufactured goods.

It is proper in closing this part of the subject to quote a short paragraph which appears in the Argentine Year Book, recently published, from the pen of Mr. Tidblom, Chief of the National Department of Agriculture and Live-Stock Industry. In closing a long article on the Agriculture of Argentina he makes the following statement:

Nature has undoubtedly endowed Argentina with advantages for agricultural and pastoral farming not to be found in any other country of the world; and it is not too bold a forecast to say that if the country continues to improve her natural gifts in the same degree in which they have been cared for and improved up to the present time the day will come when the Argentine farmers will have absolute control of the world's food markets.

The money of the country is on a paper basis, and the minimum value of a dollar was fixed in 1899 at 44 cents gold, or 127 per cent. premium. The market value of a gold dollar expressed in paper money varies now between \$2.27 and \$2.34, and the gold dollar of the United States is at a 4 per cent. premium over that of Argentine.

Railways have had an extensive development. In 1867 there were 355 miles; in 1880 there were 1563; in 1890, 5,862; in 1900, 10,601, of which 1,243 belong to the Government and 9,358 to foreign companies. In length of line Argentine stands ninth on the list of countries; but, as compared with the United States, the mileage is about 5 per cent. The paid-up capital is \$550,000,000 (gold). The total receipts in 1900 were \$40,000,000 (gold). The length of line per one thousand inhabitants is 3.46 kilometres; while it is 4.86 in the United States, 0.93 in Germany, and 1.70 in France.

The great Southern, the Western, and some other lines are still making extensions, and the Southern has crossed the Neuquen River, and is looking for a pass to cross the Andes.

There are three gauges—5 feet (which is really the standard), 4 feet 8½ inches, and a narrow gauge, usually about 3 feet 3 inches.

The total length of telegraph lines is 28,000 miles, of which 12,000 belong to the Government. In the United States the Western Union alone has 192,705 miles of poles and cables.

One of the most interesting railroad lines now in construction is the Transandine, which, upon leaving Mendoza, follows the Mendoza River to its source and climbs to the summit of the Pass of the Andes, 3,900 metres (13,000 feet) above sea-level. The Abt system of adhesion up to 2½ per cent., and then Rack to six per cent. is employed.

Some very interesting views can be had of the approach from the Argentine side. Lofty mountains, rugged slopes, rushing

rivers and the Puente del Inca (the Incas' bridge), a natural bridge formed evidently by the river breaking through a great deposit of cemented material, caused by an avalanche. The railroad is not completed, and some of the most difficult work is yet to be done.

Speaking generally of the railroads, they are well constructed, though good ballast on the great plains is lacking. The cars are like American cars, but the first-class day coaches are much more luxurious than ours. All the long-distance trains have comfortable sleepers; a buffet and dining car goes with all through trains.

In regard to the industries of the country, while the main products are agricultural and the export as well, important industries are slowly developing. While sugar is an agricultural product, the 40 sugar mills may be classed among the industries. In 1870 Argentine imported 22,000 tons, but in 1889 exported 58,000 tons. There are \$52,000,000 invested.

There are over 60 breweries in the country. The annual product is about 4,400,000 gallons.

There are 182 distilleries; the alcohol is made principally from corn. The annual product is about 8,000,000 gallons.

Milling is a very important industry. The first steam flour mill was built in Buenos Aires in 1845. In 1895, by the census of that year, there were 659 mills—234 worked by steam and 303 by water; the total amount of flour made was 383,147 tons. The country now exports about 80,000 tons, all in bags and mostly to Brazil, valued at about \$3,000,000 (gold). At present the Brazilian market is giving a preference to United States flour because it arrives in barrels, which must lead to the same method in Argentine, although the wood suitable for barrel staves is very limited.

The wine industry is one of the most important. The soil suitable for grapes covers an immense area, extending from the northern to the southern provinces along the slopes of the mountains. Mendoza and San Juan, west of Buenos Aires, are, however, the best adapted to vine-growing. In 1900 there were 89,000 acres in vines, valued at about \$10,000,000 (gold). The transportation of the wine by rail in 1901, in Mendoza alone, amounted to 160,000 tons, and the stock of wine in the wine establishments (bodegas) was 33,000,000 litres (8,700,000 gallons).

The dairy industry a few years ago had practically no existence, and nothing at all was done with the milk of the millions of cows in the country. Now large dairies are springing up in all the pastoral parts of the country; the neatest and most tempting places to enter in the city of Buenos Aires are the white-painted, scrupu-

lously clean places for drinking milk, scattered all over the city, the milk being sent in from the great "estancias." These dairies are being built in the most approved style, and they prepare pasteurized, maternized, sterilized, and all other kinds of milk preparations. The exports of butter alone in 1901 were 3,322,391 pounds. In the year 1895 it was only 880,000 pounds.

Iron and steel industries are important, although there is practically no ore or coal in the country. In 1895 there were 154 iron foundries and 156 repair shops, with a capital of \$15,000,000. Every class of machinery is now manufactured, even to small engines and boilers.

Matches: the tax alone in 1899 amounted to \$2,000,000.

Tobacco: the excise tax on which and its products in 1901 amounted to \$4,200,000 (gold).

Four million dollars (gold) are invested in textile manufactures employing 6,200 persons; canvas factories one million (gold) employing 2,000 persons and making 5,000,000 yards, and ten million dollars in hat factories employing 700 hands.

As to mining, there are valuable copper mines containing gold and silver, also rich veins of gold, with recent discoveries of iron ore; but these various products have not been developed to any great extent, due to remoteness from railroads and the roughness of the country, making the exportation very costly. The minerals include gold, borax, copper, marble, silver ore, lead ore, etc.

After these cursory statistics, it is a relief to turn to the beautiful and really great city—Buenos Ayres, and give you a brief outline of its most important characteristics.

Its early history is full of trouble. Founded in 1535, destroyed and rebuilt; and then from 1650, when there were 400 houses, it grew slowly under the old Spanish régime, and later, under dictators and bad rulers, it slowly advanced in spite of an unstable Government. In 1852, when the noted Rosas was turned out, it had 76,000 inhabitants. Chicago was just then passing through the hard trials of a little Western town, and had not more than 20,000 people. In 1864 Buenos Aires had 140,000 inhabitants, and Chicago about the same; in 1869, 178,000. But Chicago had already started on its phenomenal growth and reached over 300,000. In 1887 Buenos Aires had 400,000, and Chicago 1,000,000.

In September, 1902, Buenos Aires had 861,513, and it is growing at the rate of about 40 per cent. per decade. It is destined to reach the million mark by the year 1906. It is now the largest city in the world south of Philadelphia, if we except Chinese cities.

Comparing its present rate of growth per decade with some other cities, we find the following: Greater London, 20 per cent. ; New York, 37 per cent. ; Chicago, 54 per cent. ; Philadelphia, 23 per cent. ; Greater Berlin, 19 per cent. ; Buenos Aires, 40 per cent.

The city is on the right bank of the River Plate, a sloping bank 50 or 60 feet above the level of water, rising up to considerably greater elevations in the centre of the city. It is about 120 miles from the sea at Monte Video. Its area is one of the greatest in the world, 44,830 acres. Paris has only 19,280; Berlin, 15,625; Hamburg, 15,681; and Vienna, 13,690. It would be a good day's journey to go around the city, as its perimeter measures 39 miles.

As far as the natural conditions permit the streets are laid out in the form of a chessboard, and are generally about 360 feet apart from centre to centre. In the central part of the city the streets are narrow; it is difficult for three carriages to pass. There are, however, a few 33 feet wide, and one or two avenues of about a hundred feet.

The finest, and said to be best-lighted street in the world, is the Avenida de Mayo, which is in the centre of the city as to the numbering of the houses north and south. It has a fine asphalt pavement and double electric lights in the centre. It was cut through the blocks a few years ago from the Casa de Gobierno (Government House), near the port to the 13th street, somewhat less than a mile. At the other end there is being built a beautiful capitol building that will cost about \$5,000,000 (gold).

There are 72 parks and small areas outside the main streets, with a combined area of about 1,400 acres. These parks are more tastefully laid out and more neatly kept than can be found in any other country in the world, Paris excepted. In fact, in many respects the city, in its streets, lights, parks and structures, resembles Paris, except that there are more one-story residences than in Paris. The prevailing style is Spanish, with a patio (a kind of open area) and the rooms all facing it, and in this patio a garden and fountain, when the proprietor is able to have it; if not, pots of flowers very much like the ordinary city house in Mexico. The style of the houses of the wealthy may be seen on Avenida Alvear.

The pavements are wood (nearly all hard, suitable wood of the country), asphalt, granite blocks, macadam and rubble. No city has better pavements in the central part. In the outskirts, however, much of the pavement is very bad and uneven, merely rubble; but immense sums are being expended in substituting granite blocks and asphalt for rubble.

There is no city anywhere with more lines of street cars—in fact, with the exception of two streets, there is a line in every one of the principal thoroughfares. And leading out to the pleasant suburban towns—Belgrano, Palermo, and Flores—there are electric lines similar to those in American cities, using the overhead trolley. In fact, all the equipment from rails to trolley comes from the United States. Very extensive changes are being made in all parts of the city, substituting electric for horse cars. There are now 275 miles of street-car lines, which carried, in 1900, 116,447,982 passengers.

There is a project and a national concession for a system of underground electric tram lines, connecting the three main railway stations with the Plaza Victoria, and in one direction extending by a surface line far out in the country. If underground lines pay in any city in the world they will in Buenos Aires, for the conditions are especially adapted to their easy construction, the material being suitable for tunnelling, and a great mass of people crowded into the "Centre," with its narrow streets, where the present surface movement is often extremely congested. A United States citizen has the concession.

In 1868 there was a terrible epidemic of yellow fever, due, in a large part, to unsanitary conditions; but immediately afterward the city began a very extensive system of water and drainage works, costing thirty-three millions of dollars (gold), discharging the sewerage fifteen miles distant, and the storm waters, by great intercepting sewers, now being completed, into the river in front of the city. The city waterworks take their water above the city, where it is never contaminated. These works were designed by Messrs. Bateman and Parsons, of London, and the main construction was carried out under their supervision.

The water of the River Plate is good, but muddy, and it is clarified in settling-basins before being delivered to the distributing reservoir, built on one of the highest points of the city. The distributing reservoir is a work of art, covered with glazed tiles over pressed brick. These works all together have made Buenos Aires one of the healthiest cities in the world, as the death-rate proves.

Ten years ago, upon the completion of the main works, the mortality per 1,000 was 30; now it is 16½. This compares very favorably with other large cities. London has 19.2, Glasgow 21.6, Liverpool 26.3, Manchester 24.1, Dublin 30.4, Paris 20.1, St. Petersburg 24.7, Vienna 20.7, Madrid 30.1, Rome 17.6, Venice 22.8, New York 19.7, Philadelphia 17.7, Brussels 17.9, Boston 19.0, and New Orleans (white) 17.9.

The Government is soon to extend the works at a cost of five millions (gold).

The climate, taking the whole year round, is very equable and very agreeable. The parks are always green; vines and palms and a species of banana plants are seen everywhere, and flowers all the year in the open. It has a semi-tropical country in the north and in Paraguay from which to procure the plants, where the *Victoria Regia* and other beautiful plants grow wild.

In reference to education the primary education is compulsory from the age of nine to fourteen; secondary education, from fourteen to nineteen, is optional, as also the university, or higher education, from nineteen to twenty-five or twenty-six. No man can enter into any of the professions, including engineering, and take a prominent position in the Government without being a graduate of the National University and having taken the course outlined in the above division of ages.

In 1900 there were 450,000 pupils in the public schools, which are free to all, and free to people of all religions. Although the Catholic religion is the national religion, neither it nor any other religion is allowed to be taught in the schools.

In the National University there are four faculties—law and social science, medicine, exact physical and natural science, and philosophy and letters. In 1901 there were 3,562 students in the University.

In reference to religion all may worship God freely, according to the dictates of their own conscience. While the Government itself, like the Government of Great Britain, Germany, Switzerland, etc., recognizes an established Church and assists in its maintenance, it also often assists in benevolent and educational work undertaken by other denominations.

A very important work of this kind is the Argentine Evangelical Schools, initiated, promoted, and carried on by Mr. William C. Morris. The report of 1901, just issued, shows there were 1,820 pupils in various departments; in the previous year there were 1,076. This school is really a national school, and is assisted in a measure by Congress, although largely dependent upon private subscriptions, which are made to it by not only Protestants but by leading Catholics as well. It is devoted entirely to the education and care of children of the poor who cannot enter the public schools for want of suitable clothing.

The general style of the city is cosmopolitan—in buildings, in stores, in residences, in dress, in habits and customs of the people.

It is made-up of many nationalities. According to the census of 1895, there were in the country about 3,000,000 Argentines (all children born there of foreign parents are Argentines) and about 500,000 Italians—by far the largest number of immigrants, and they are far better than the immigrants of the same nationality that come to the United States. Some of the best and most intelligent people in all kinds of business and industries, especially in agriculture, are Italians. Next come the Spaniards, about 200,000; next the French, somewhat less than 100,000; next the English, 22,000; next the Swiss, 15,000; and lastly the North Americans, as we are called, 1,400. These figures refer to the year 1895. The number of foreigners in the country December 31, 1899, was 1,199,808—an increase of 20 per cent. on the returns of the year 1895.

Immigrants in 44 years.....	1,935,077
Italians “ “	1,198,550
Spaniards “ “	361,079
French “ “	162,636
British “ “	34,031
Austrians “ “	31,698
Germans “ “	27,834
Swiss “ “	24,873
Belgians “ “	19,082

The history of the lighting of streets in the city is very interesting, and shows that the city keeps pace with others in this respect. The first record of public lighting was in 1778, when the city had lamps in the shape of a tin of horse-oil with a wick; then came tallow dips, then oil lamps; then came gas in 1885, and in 1888 electricity began to replace it in part; and on December 31st, 1900, the city was lighted with 889 arc lamps, 318 incandescent of 16 cp., 14,084 gas lamps, many with the Welsbach burner, and 8,590 kerosene lamps, and there were 36 electric light stations, with a capital of 9 million dollars (gold), and with a capacity of 23,300 electric horse-power.

In addition to telegraph lines there are four cable companies working with Europe and the United States. The service is very good and prompt; its time of transmission between Buenos Aires and London, “via Galveston” and Western Union lines and cables, is about 60 minutes, and with New York 30 minutes.

It is an interesting fact that the difference in level between the highest point on land of the lines of the Central and South Ameri-

can Telegraph Company and the lowest point of its cables in the Pacific Ocean is about 31,000 feet—six miles.

This company has three underground cables which cross the Andes and work uninterruptedly, though covered with snow for eight months of the year.

The telephone service is in the hands of private companies. The capital invested is over \$10,000,000 (gold); there are about 11,000 subscribers. There are no real long-distance lines, except one recently opened to Rosario.

The house-fronts, when kept in repair and painted, are neat and architecturally beautiful. The words "repair" and "painted" must be explained. There are no wooden houses, which these words might imply; they are almost always made of rough brick, covered with what is called *revoque*, a covering of plaster or "staff," and sometimes artificial stone. The better class of houses generally have a base of granite, marble, or other natural stone three or four feet high, and then brick covered with *revoque*. Sometimes the natural stone extends to the second story, and then invariably comes the artificial covering; after a while—two or three years—this begins to discolor and flake off, requiring painting and repairing; after ten years it begins to become an eyesore, and at the end of twenty years it must come off at considerable expense. An instance to be cited is the American Church, Methodist Episcopal, which was built 25 years ago, but for five or six years past has presented such a dilapidated appearance that it has become necessary to remove the *revoque* from the sides and front from the base to the steeple and renew it at a cost of \$10,000—a large sum for a poor church.

The means of locomotion about the city are abundant—street cars everywhere, and a very good and economical cab service. There are few coupés, no public hansoms, and only one or two private ones; but the street carriages are two-horse victorias, which carry four people. The private turnouts are equal to those of any city of the United States, especially the horses, which are of the best imported stock. The "Corso" and the approaches to it on a Saturday or Sunday afternoon are very attractive. It is in the beautiful park of Palermo, one of the suburbs—broad avenues, beautiful shrubbery, lakes and shady drives, and immediately in front the broad river Plate, whose further shore is beyond the horizon.

The people show great taste in the arrangement of their stores, and particularly the shop windows; from a butcher's shop to a con-

fectioner's and a lace store the fine French taste is visible everywhere. A walk along Florida, the principal shopping street—a fine asphalt street with no street cars in it—is one of the delights of Buenos Aires, and one never tires of it. If for a fortnight you miss this promenade you hardly know the street, for the appearance of the stores has greatly changed in the meantime by a complete change of the decorations.

The manner of living is Continental—a cup of coffee with a roll in the early morning; breakfast at 11 to 12.30 (which is a meal in courses), and dinner at 7.30, the principal meal of the day. This is the custom among all classes, high and low. And there is another custom (it is strange how soon you fall into it): tea or coffee or mate (a species of steeped herb—yerba—pressed into a peculiar little gourd used as a bowl and drawn out of it with a hollow silver tube called a mate stick). This 4 o'clock drink is as necessary as any meal. In the Government House (Casa de Gobierno) the Government provides tea or coffee for all of its officials and employés.

The foreign debt of the National Government in 1900 was \$338,771,614 (gold), and the international debt \$3,322,500 (gold). There are thirty different loans, the interest on which ranges from $3\frac{1}{2}$ to 6 per cent.; the total interest charge in 1900 was \$22,349,900.84 (gold). It requires annually, to pay the interest on the total debt, \$18,661,864 (gold) and \$11,695,218 (paper).

The total revenue of the Government in 1900 was \$62,045,458 paper and \$37,998,704 (gold).

It is generally known that in 1890 a terrible financial crash came upon the country, at the time of the Baring failure; since then it has had to struggle to carry the load imposed by the disasters of those days.

Besides Spanish, the national language, French, Italian, English, and German are spoken almost everywhere.

A brief résumé of the ocean commerce will give significant figures.

In 1899 the value in gold of goods imported into Argentine was about \$117,000,000, and exported \$185,000,000. Of these \$44,000,000 imports came from Great Britain and \$15,000,000 from the United States; Italy comes next with \$14,000,000, and Germany next with \$13,000,000; then France with \$11,000,000, and Belgium with \$9,000,000. But exports show a different distribution, for France took \$41,000,000, Germany \$29,000,000, Belgium \$24,000,000, Great Britain \$22,000,000, the United States \$8,000,000, and

Italy \$5,000,000. Of the foreign trade Buenos Aires had 87.2 per cent. of the imports, Rosario 8.8, La Plata 1.2, and Bahia Blanca 0.80. Of the exports Buenos Aires had 55.5 per cent., Rosario 18.4, La Plata 2.30, and Bahia Blanca 7.00. These ports are mentioned as some information about them is needed to explain the commercial situation. Of all the goods reaching the River Plate countries 80 per cent. comes to Argentine.

In 1885 the National Government began the construction of very large docks at Buenos Aires; hitherto all the business had been done from the anchorage, about 12 miles from the city, the intervening space being a great mud bar, the water from a depth of 25 feet gradually shoaling to the shore-line at the city. This was so flat that it was necessary often to transfer the passengers and goods from the lighters, with which they had come from the vessels, to small boats and to great wheel-carts that went out a long distance in the water to meet the lighters.

The new docks are very extensive, and lie along the immediate front of the city and connected with it; they were designed by the English firm of engineers Hawkshaw and Hayter and carried out under the supervision of Mr. James Dobson, the resident engineer. The concessionaire was an Argentine citizen, Mr. Madero; the contractors were the experienced English firm of Walker & Co., who built the Manchester Ship Canal. These men all deserve the highest credit for carrying through, under the financial difficulties of the period above mentioned, a great public work, costing \$38,000,000 (gold).

In order to reach the docks from the sea a channel had to be excavated in the mud foreshore from the anchorage. This channel (the north one) is at low tide 21 feet deep and 330 feet wide, and about $5\frac{1}{2}$ miles long from its intersection with a channel which already existed by previous dredging from the other end of the port, at the mouth of a small, sluggish stream called the Riachuelo, in which channel there generally is about 19 feet of water at low tide. The tide of 2 or 3 feet, depending largely upon the direction and force of the wind and very uncertain, permits vessels drawing about $23\frac{1}{2}$ feet to enter the port by the north channel. The new port was connected with the older port, and now both channels are being used, and the depths in them are about as I have stated.

The Government has recently begun the extension of the north channel straight out to the anchorage, and later will deepen it to 22 feet. In the meantime the navigation uses a crooked channel

beyond the intersection, which has been partly dredged, curving round from the south channel to the anchorage. The depth of water in the northern entrance basin of the port is 21 feet, but in the four great docks 23 feet, with tidal gates so that the vessels at low tide may be afloat.

The works are built in the most substantial manner—masonry walls founded on what is called “tosca” (loess), the hard substratum that is found in this part of the country. The four docks, or basins, are from 620 to 750 yards long, and are all 170 yards wide, connected by passageways 22 to 27 yards wide, over which passes, by hydraulic turning bridges, the foot, vehicular, and rail traffic. A sea wall in front protects the entire port. On the city side are three and four story brick warehouses, 24 in all, with a total frontage of $1\frac{1}{2}$ miles. Sheds, cattle yards, railroad tracks, hydraulic cranes and capstans, and other important appurtenances give the port modern facilities for handling cargo.

When the docks were opened at the southern end in 1899 the registered tonnage of vessels arriving and departing at the Port of Buenos Aires was 3,800,000; in 1901, 8,661,299—more than 100 per cent. increase. There are only twelve ports in the world of greater tonnage, and none of them show such phenomenal growth.

In 1880, about the time that the works were proposed, the tonnage was 644,570, and the plans were made for 2,000,000 tons only.

The extraordinary growth of the commerce has made it necessary to make an enlargement of the facilities, and this was one of the works intrusted to me during the last year of my stay in Argentine. With the proposed enlargement, the port will have free access from the sea and a depth of 26 feet.

The plan also provides facilities for “inflammables”—coal, petroleum, gasoline, naphtha, and some explosives.

The Standard Oil Company of New York is now arranging to bring bulk oil in tank steamers to Argentine, and the Shell Transport Company is preparing to make a specialty of the importation of fuel oil from Texas and the Dutch East Indies. The work of enlargement of the port is divided into sections, so that it can be carried out section by section as the increase of commerce will require. The general plan also includes the protection and deepening of the entrance channels.

One of the principal ports of the country is Rosario. Ocean navigation reaches it, and, for that matter, reaches Colastiné, the

port of the City of Santa Fé, the capital of the Province. The registered tonnage of the port of Rosario in 1899 was 3,000,000, of which more than 2,000,000 were over-sea vessels, about 700 per annum. The merchandise entered and cleared was about 1,650,000 tons; 67 per cent. of the exportation was wheat. In the busy months there are often over 30 vessels seen at one time along the wharves and the barranca, where the wheat is loaded in bags, sliding down from the high cliff 60 feet above the vessel. The imports amount to about \$10,000,000 (gold), and the exports to \$30,000,000.

The National Government is making a great port of Rosario, endowed with all modern facilities for handling cargo. It sent out to Europe and the United States a full report, with all necessary data, submitting the project to capitalists and contractors, with the request for propositions to build and operate the port. It will cost from \$10,000,000 to \$12,000,000 (gold).

The contract, after an examination of and report upon the projects presented by a Board of which I had the honor to be President, has been let to the well-known and experienced firm of contractors Messrs. Hersent, of Paris, associated with Schneider and Co., of Creusot, France. The works of construction were inaugurated by the President of the Republic on Oct. 26th, 1902.

The plans of the work have been based on the data above mentioned.

Some important problems had to be solved in connection with the improvement of so great a river as the Paraná, the bed of which is subject to such important changes, and also its islands and banks.

The front line of the proposed wharves is over $2\frac{1}{2}$ miles long. The masonry piers must go down into the tertiary sand below the scour of the river, and their foundations will be from 60 to 80 feet below the low-water level.

The importance of this work, furnishing a modern seaport to the second city of the country, can scarcely be overestimated. In my report on the project made in Sept., 1900, I used the following words, which two years of subsequent study have corroborated:

It is safe to say that the establishment of a first-class port at Rosario, with suitable channels of access, will revolutionize completely the commerce and industry of this Republic.

La Plata port and city were built by the Provincial Government, when, in about 1880, the National Government came to Buenos Aires to occupy it as the capital of the nation. La Plata is an

excellent port; it is built on the shore of the Rio de la Plata, about 35 miles from Buenos Aires, and cost about \$14,000,000 (gold). The opening of the national port at Buenos Aires has driven most of the commerce from La Plata; but it is capable of being made, with a comparatively small sum of money, deep enough, in its entrance channel (five miles long) and in its port areas, to accommodate vessels of 26 feet draught at low tide; it now has 21 feet.

The remaining port of importance and rapidly growing is outside of the River Plate, in the south, Bahia Blanca; it is the principal shipping port of agricultural products by the great Southern Railway, the largest system in the Republic. This port is in an estuary of the ocean, and is a protected harbor; in fact, the terminal of the railway is about 35 miles from the open ocean. The Railway is building a steel pier, 1,640 feet long, with spacious warehouses and 19 miles of siding; and there will be, when all works are completed, over half a mile of wharf frontage, supplied with electric cranes.

The National Government is building in this estuary at Puerto Militar, or Puerto Belgrano, a system of dry docks and basins on a large scale. The first dry dock, one of the best and largest in the world, is completed and now in use. It was designed and built under the immediate supervision of the well-known Italian engineer, Chev. Luigi Luiggi, who had charge of similar work at Genoa.

This dock, built of first-class materials and upon the most modern methods, can take the largest naval or merchant ships of the world, as it has a useful length of 713 feet and an entrance width of 85 feet, and a depth over the sill of $32\frac{1}{2}$ feet at mean high tide, 22 feet at low tide. It has intermediate gates, so that two or three small vessels can be docked at the same time or separately.

The plans, photographs, and possibly a relief model of this dock will be exhibited at the World's Fair in St. Louis in 1904.

In October, 1902, the U. S. battleship Iowa, the flagship of the South Atlantic Squadron, was docked at Puerto Militar.

It is gratifying to know that at Buenos Aires there is a large business with New York by means of five steamship lines, and, through New York, with Chicago and other cities, from which are shipped a large amount of agricultural machinery of all classes—from cultivators and ploughs to great steam threshing machines of the J. I. Case Co., of Racine, Wisconsin. Not only from Chicago but from all manufacturing districts the trade of our country is increasing. You see our machinery everywhere, and it is everywhere considered equal to any—Baldwin locomotives, Jackson and Sharp cars, and Harlan and Hollingsworth's. The American

freight car of 25 and 30 tons is replacing the old Belgian, French, and English 7 and 10-ton cars. If the American cars are not all made in the United States they are copied from ours. The most approved bridges are from the United States. Large quantities of Southern and Oregon pines are imported. From the United States comes all the kerosene used. I might go on enumerating many other United States products. I can well say that the prospects of American trade with Argentine are exceedingly good.

The Argentine Government is determined to improve the great rivers of the country by methods which have been found to be best in other countries under similar conditions. The results of our experience upon the Mississippi are being closely watched, studied, and applied. The reports of the Mississippi River Commission are of great value to that country. I may further say that the Argentine engineers and the methods pursued by them are equal to those of any country. Every Government engineer, to take a prominent position, must have a diploma from the Engineering Department of the National University. The graduates of this excellent school are as well equipped for their work as those from any school in the world; this I know by experience, for four of them (young men) have been associated with me as my immediate assistants, and in my position as consulting engineer of the Government I have been brought into close relations with many other engineers and I have the highest opinion of their ability.

The Sarmiento School commemorates one of the most learned and best of Presidents, who, when he was Minister at Washington, engaged a large number of our young lady teachers to go to Argentine as Normal School teachers. Many of them are there yet after nearly twenty years' service—a service that has reflected honor upon themselves and their country.

In two years of close relations with the country, and especially with the Government officials, I formed a very favorable idea of the character of the people and of the possibilities of business and profitable enterprise for our own people there. The officials of the Government and the leading men of the country desire to have us come to Argentine with business energy, integrity, and ability to help build up that great country of South America, so like our own in its climate, soil, rivers, coast-line, and other general features.